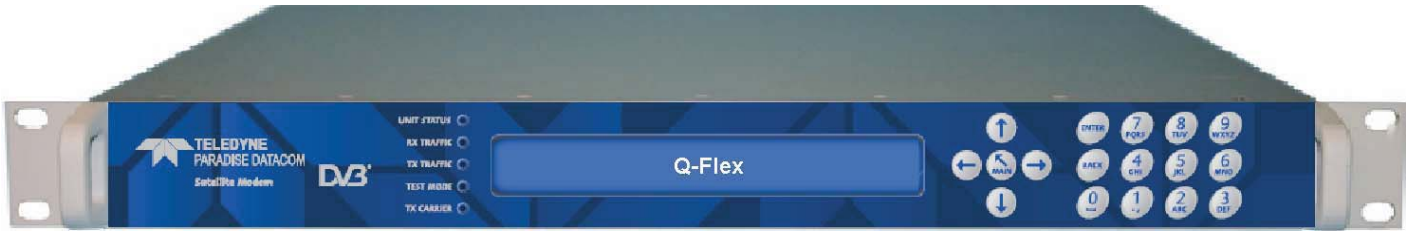
TELEDYNE
PARADISE DATACOM
A Teledyne Technologies Company

Q-Flex™

Dual IF/L-Band Satellite Modem

DVB S2



OVERVIEW

The Q-Flex™ modem embodies a new concept in SCPC satellite modem technology - a ***flexible software-defined modem*** that does what you want, now and in the future.

The Q-Flex™ modem's ***flexible hardware platform*** provides IF and L-band operation in one unit. While its powerful processor makes it ideal for handling IP traffic, the Q-Flex™ modem can be fitted with virtually any type of terrestrial interface and will operate at data rates up to 155Mbps.

Flexible pricing is achieved by enabling only the features you need at any time. ***Future-proofing*** is assured by convenient software upgrades via Ethernet or a memory stick.

Advanced Bandwidth-Efficient Features

The Q-Flex™ modem supports the most powerful bandwidth-saving technology available.

Paired Carrier™ overlays transmit and receive carriers reducing satellite bandwidth by 50% (using ViaSat's patented PCMA technology).

FastLink™ low-latency LDPC has been designed for latency-sensitive applications while giving coding gain that is close to the theoretical limits. DVB-S2, renowned for its robustness and bandwidth efficiency, is also supported.

Advanced bandwidth-saving IP features include acceleration and header and payload compression.

FEATURES

- Dual IF/L-band operation
- Data rates to 155Mbps
- **XStream IP™** is an integrated suite of advanced IP optimization and traffic management features including TCP acceleration, header and payload compression, dynamic routing, traffic shaping, encryption and ACM
- DVB-S2, FastLink LDPC, TPC FEC options
- Terrestrial interface options including Ethernet, EIA-530, G.703, OC-3, STM-1, LVDS, ASI and HSSI
- Modulation up to 64QAM
- Optimized spectral roll-offs, including 5%
- **Paired Carrier™** option
- **LinkGuard™** signal-under-carrier interference detection
- Built-in spectrum and constellation monitors
- IPv4/IPv6 compliant
- Interoperable with other Paradise modems
- Truly low cost: Related features bundled together for better value!

Applications

- IP trunking
- Corporate networking
- Mobile backhaul
- Disaster recovery
- Maritime communications
- Satellite news gathering
- G.703 backhaul

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Dual IF/L-Band Satellite Modem

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Main Specifications

Frequency	IF: 50 to 90MHz & 100 to 180MHz (resolution 100Hz) (BNC connector) L-band: 950 to 2050MHz (resolution 100Hz) (N-type connector)
Data Rate	DVB-S2: 50kbps to 155Mbps FastLink LDPC: 4.8kbps to 100Mbps TPC: 4.8kbps to 60Mbps 1bps resolution Operation to 2,048kbps provided as standard; extension options to 5Mbps, 10Mbps, 25Mbps, 60Mbps, 100Mbps and 155Mbps
Symbol Rate	DVB-S2: 100ksps to 45Msps Non-DVB-S2: 9.6ksps to 40Msps
Operating Modes	DVB-S2 (EN 302 307) option Closed Network (+ ESC) (IESS-315) IBS/IDR (IESS-308/309/310/314) options
Scrambling	DVB-S2: as per EN 302 307 IBS: Synchronised to framing per IESS-309 Closed Network + ESC: Synchronised to ESC overhead
Impedance	IF: 50Ω/75Ω L-band: 50Ω
Return Loss	IF: 18dB typical L-band: 14dB typical
Redundancy	Can be operated in standalone, 1:1 or up to 1:16 redundancy configuration

Traffic Interfaces

Base modem (standard):
- Ethernet (10/100/1000 BaseT) IP traffic on RJ45 with processing capability of 100,000 packets per second

Traffic options:
- EIA-530 (RS422, X.21, V.35 and RS232 on 25-pin D-type female)
- G.703 (balanced on RJ45; unbalanced 75Ω BNC female)
- Quad E1 G.703 (balanced RJ45)
- Quad ASI (75Ω BNC female)
- STM-1/OC-3/Optical Gigabit Ethernet (small form-factor pluggable module)
- Serial LVDS (25-pin D-type female)
- HSSI (50-pin HD SCSI-2 connector)
- IDR (to IESS 308; 50-way female D type connector)

MultiMux option: generates a single carrier from any mixture of G.703, IP and EIA-530 traffic (requires Quad E1 option)

Modulator

Output Power	IF: 0 to –25dBm (0.1dB steps) L-band: 0 to –30dBm (0.1dB steps)
Output Power Stability	±0.5dB, 0ºC to 50ºC
Transmit Filter Roll-off	5%, 10%, 15%, 20%, 25%, 35%
Phase Accuracy	±2º maximum
Amplitude Accuracy	±0.2dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	As IESS-316, nominally 3dB better
Harmonics	Better than –55dBc/ 4kHz in band
Spurious	Better than –55dBc/ 4kHz in band
Transmit On/Off Ratio	55dB minimum
BUC PSU Option	24V or 48V DC via IFL cable, 200W
BUC 10MHz Reference	Via IFL cable; 10MHz ± 0.001 ppm; 3dBm ± 3dB
FSK Control	Allows monitor & control of a compatible L-band BUC or IF Transceiver from the modem via the Tx IFL cable

Demodulator

Input Range	IF minimum: -115+10 log (symbol rate) L-band minimum: -130 + 10 log (symbol rate) IF/L-band maximum: -80 + 10 log (symbol rate)
Maximum Composite Signal	+10dBm
Wanted-to-composite Level	IF: -94 + 10 log (symbol rate) L-band: -102 + 10 log (symbol rate)
Frequency Sweep Width	±1kHz to ±32kHz up to 10 Msps (1kHz steps) ±10kHz to ±250kHz above 10 Msps (10kHz steps)
Acquisition Time	Dependent on FEC, data rate and sweep width (at 9.6kbps, less than 1s at 6dB Es/No QPSK; at 10Mbps, less than 100ms at 6dB Es/No QPSK)
Clock Tracking Range	±100ppm minimum
Receive Filter Roll-off	5%, 10%, 15% 20%, 25%, 35%
Performance Monitoring	Eb/No (range 0 to 15dB, ±0.2dB) Frequency offset (100Hz resolution) Receive signal level Buffer fill status
AGC Output	Buffered direct AGC output for antenna peaking
LNB 10MHz Reference	Via IFL cable; 10MHz ± 0.001 ppm; 0dBm ± 3dB
LNB Voltage	Selectable 15 or 24V DC to LNB via IFL cable; maximum 0.5A

Forward Error Correction

Modulation	DVB-S2 (Option): QPSK, 8PSK, 16APSK Non-DVB-S2: BPSK, QPSK, OQPSK, 8PSK, 16QAM, FastLink 8QAM, FastLink 16APSK, FastLink 32APSK, FastLink 64QAM
FEC	DVB-S2 (LDPC/BCH) option: QPSK 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 8PSK 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 16APSK 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 Non-DVB-S2: FastLink Low-Latency LDPC option: BPSK 0.499 (O)QPSK 0.532, 0.639, 0.710, 0.798 8PSK/8QAM: 0.639, 0.710, 0.778 16APSK/16QAM: 0.726, 0.778, 0.828, 0.851 32APSK: 0.778, 0.828, 0.886, 0.938 64QAM: 0.828, 0.886, 0.938, 0.960 TPC option: BPSK 5/16, 21/44, 3/4, 7/8 (O)QPSK: 5/16, 21/44, 3/4, 7/8, 0.93 8PSK: 3/4, 7/8, 0.93 16QAM: 3/4, 7/8, 0.93 Viterbi: BPSK/(O)QPSK 1/2, 3/4, 7/8 TCM option: 8PSK 2/3 Sequential option: BPSK/(O)QPSK 1/2, 3/4, 7/8 Reed-Solomon outer codec available with Viterbi and TCM

Ethernet Traffic: Standard Features

Note that the maximum modem IP throughput depends on traffic format and the features enabled. Bridged IP data can be processed up to the modem maximum data rate. Please seek assistance from Teledyne Paradise Datacom in evaluating your particular requirements.

Bridging and Static Routing	Bridging Static routing
IPv4/IPv6	Dual IPV4/IPV6 TCP/IP stack allowing use of both IPv4 and IPv6 addresses for bridging and routing of traffic
VLAN Support	IEEE 802.1q VLAN support
	IEEE 802.1p Quality of Service (packet prioritisation) using strict priority or fair weighting queuing
DHCP, SNMP	DHCP (standard) for automatic allocation of M&C IP address. SNMP (standard) v1, v2c and v3
Web Server	Embedded web server M&C interface (standard)
IP Diagnostic Graphs	Shows Tx, Rx throughput (bps, pps); dropped, errored packet counts (standard)

Ethernet Traffic: XStream IP™ Option

XStream IP™ is an integrated set of IP optimization and traffic management features designed for maximum reliability and bandwidth efficiency.

Traffic Shaping	Provides guaranteed throughput levels for IP streams, using Committed Information Rate and Burst Information Rate settings. Stream differentiation is by IP address, IEEE 802.1p priority class, Diffserv DSCP class or MPLS EXP field
Header Compression	Robust Header Compression to RFC 3095. Reduces Ethernet/IP/UDP/TCP/RTP header sizes typically by 90%. 1-way packet processing limit: 60,000 pps; 2-way limit: 45,000 pps. Includes Ethernet header compression (compresses 14-byte Ethernet frame to typically one byte)
Payload Compression	Uses Deflate algorithm (RFC 1951) to compress all TCP/IP packets (TCP and UDP), typically resulting in compression of payloads by 50%
Dynamic Routing	RIP V1, V2; OSPF V2, V3; BGP V4
TCP Acceleration	Typical throughput level of 90% of link capacity. Supports 10,000 concurrent accelerated TCP connections (plus at least 40,000 unaccelerated TCP connections) up to the modem maximum data rate
DVB-S2 ACM *(Requires DVB-S2 hardware option)*	Dynamically varies modcod with varying link conditions, maximising throughput at all times by converting unused link margin into additional throughput
IP-over-DVB-S2 Encapsulation *(Requires DVB-S2 hardware option)*	Supports the transmission of IP packets (or optionally, full Ethernet frames) over DVB-S2; encapsulates & decapsulates using MPE (EN 301 192), ULE (RFC 4326) or Paradise PXE
AES-256 Encryption	*Note: due to export controls, encryption is supported on the **Q-FlexE™** model only. Please see separate Q-FlexE™ datasheet for more details*

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Paired Carrier™ Option

Paired Carrier™	Transmit and receive carriers are overlaid on top of each other in the same space segment. Echo cancellation techniques are used in the demodulator to cancel the transmit carrier and extract the wanted receive carrier signal
Paired Carrier data rate options *(30kHz to 54MHz occupied bandwidth)*	256kbps, 512kbps, 1024kbps, 2.5Mbps, 5Mbps, 10Mbps, 15Mbps, 20Mbps, 25Mbps, 30Mbps, 40Mbps, 50Mbps, 60Mbps, 80Mbps, 100Mbps and 155Mbps traffic rate
Power asymmetry	-10dB to +10dB
Symbol rate asymmetry	Up to 12:1
Eb/No degradation	Typically < 0.5dB (0.7dB for 16QAM/16APSK with 10dB power asymmetry)
Mobile Operation	Uses GPS data to continually recalculate position relative to satellite, allowing uninterrupted operation in mobile environments (ships, etc.) anywhere in satellite footprint

Drop & Insert

Bearer Types	T1-D4, T1-ESF, E1-G.732
Timeslot Selection	Independent selection of arbitrary timeslots for both Drop and Insert.
Bearer Generation	Terrestrial bearer may be looped through modem, or terminated after Drop Mux and a new bearer generated by the insert Mux
Timeslot ID Maintenance	Maintains the identity of individual Drop & Insert timeslots
Multi-Destinational Working	All or only a subset of the received data may be inserted into the terrestrial bearer on the receive path for multi-destinational working
Signaling	CAS and RBS are fully supported

Advanced ESC

ESC/Aux Port	Provides high-rate async ESC or Intelsat low-rate async IBS ESC	
Electrical Interface	IP, RS232, RS422 or RS485	
Async ESC	Closed Net Plus ESC	Overhead scales to any ESC baud rate from 0.5% to 70% of the main channel rate
	IBS Option	High-rate async channel (1/32nd to 2/32nd of the IBS overhead) providing async baud rates from 0.2% to 5.1% of the terrestrial rate
Advanced Aux	Intelsat low-rate async ESC carried In bit 1 of TS32 providing a synchronous channel at 1/480th of the data rate, allowing up to one quarter of this rate for over-sampled async data	

DVB-S2 Performance at PER 1e-6
Guaranteed Es/No (dB) for Normal (64k) frames

	Rate 1/4	Rate 1/3	Rate 2/5	Rate 1/2	Rate 3/5	Rate 2/3	Rate 3/4	Rate 4/5	Rate 5/6	Rate 8/9	Rate 9/10
QPSK	-1.6	-0.7	0.3	1.5	2.8	3.4	4.3	5.0	5.5	6.5	6.7
8PSK					6.4	7.2	8.5		9.8	11.0	11.3
16APSK						9.7	10.8	11.6	12.2	13.4	13.7

DVB-S2 Performance at PER 1e-6
Guaranteed Es/No (dB) for Short (16k) frames

	Rate 1/4	Rate 1/3	Rate 2/5	Rate 1/2	Rate 3/5	Rate 2/3	Rate 3/4	Rate 4/5	Rate 5/6	Rate 8/9	Rate 9/10
QPSK	-1.3	-0.4	0.5	1.9	3.0	3.5	4.4	5.2	5.6	6.7	
8PSK					6.5	7.3	8.6		9.9	11.2	11.3
16APSK						9.8	11.1	11.7	12.3	13.5	

Guaranteed Eb/No BER Performance (dB)
(Typical in brackets)

		Rate 1/2	Rate 3/4	Rate 7/8	Rate 2/3	Rate 0.93
Viterbi QPSK	1E-4	4.7 (4.4)	6.1 (5.8)	7.1 (6.8)		
	1E-8	7.2 (6.9)	8.8 (8.5)	9.5 (9.2)		
Sequential (64kbps)	1E-4	4.3 (4.0)	5.4 (5.1)	6.4 (6.1)		
	1E-8	6.4 (6.1)	7.3 (7.0)	8.6 (8.3)		
Sequential (2048kbps)	1E-4	5.6 (5.3)	6.1 (5.8)	6.9 (6.6)		
	1E-8	7.5 (7.2)	8.1 (7.8)	8.4 (8.1)		
Turbo (TPC) QPSK	1E-4	2.7 (2.4)	3.5 (3.2)	4.1 (3.8)		
	1E-6					6.3 (6.0)
	1E-8	3.3 (3.0)	4.5 (4.2)	4.5 (4.2)		6.8 (6.5)
Turbo (TPC) 8PSK	1E-4		5.6 (5.3)	6.8 (6.5)		
	1E-6					9.2 (8.9)
	1E-8		6.8 (6.3)	7.2 (6.8)		9.9 (9.6)
Turbo (TPC) 16QAM	1E-3		6.5 (6.2)	7.7 (7.4)		
	1E-6					10.0 (9.7)
	1E-7		7.8 (7.5)	8.2 (7.8)		
	1E-8					10.7 (10.4)
8PSK/TCM	1E-3				6.3 (6.0)	
	1E-8				10.4 (10.1)	
8PSK/TCM + Reed-Solomon (all rates)	1E-4				6.1 (5.8)	
	1E-10				7.3 (7.0)	

FASTLINK LOW-LATENCY LDPC: SEE SEPARATE DATASHEET

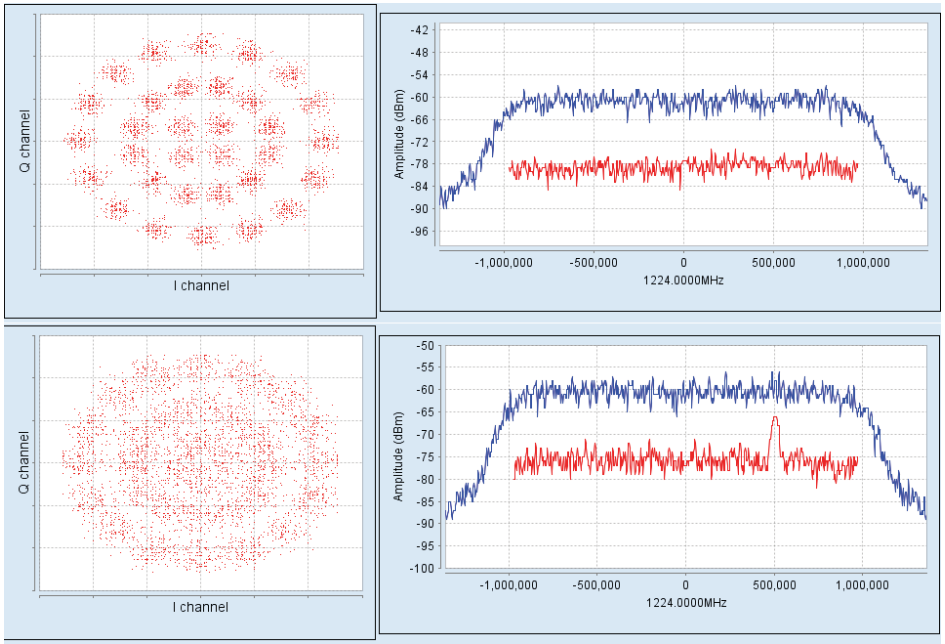
Test Facilities and Alarm Outputs

BER Tester	Bit error rate tester operates over main traffic, ESC or Aux channels, allowing BER monitoring while on traffic. Not available in DVB-S2 mode
	Supports various test patterns compatible with common BER testers
Other test modes	Transmit CW (pure carrier) Transmit alternate 1-0 pattern Simulated satellite delay for TCP/IP packets
Alarm Relays	4 Independent Form C relays for unit, Tx, Rx and backward alarms

Mechanical/Environmental

Size	1U chassis, 410mm deep excluding front panel handles and rear panel connectors and fans
Weight	3.5kg
Power Supply	90 to 250VAC, 1A @100V, 0.5A @ 240V, 47 to 63Hz Fused IEC connector (live and neutral fused); 48V DC option
Compliances	FCC, CE and RoHS compliant
Safety Standards	EN60950-1:2006
Emissions and Immunity	Emissions: EN55022:2006 Class B Immunity: EN55024:1998 (+ A1:2001 + A2:2003
Operating Temperature	0 to 50 °C
Humidity	95% relative humidity, non-condensing

Built-in Spectrum Analyser showing **LinkGuard™** *Signal-Under-Carrier interference detection without/with interferer present.*



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Fully configurable - pay only for what you need!

	Option	Description
Base Modem	✓	**4.8kbps to 2.048Mbps Closed & Closed Network + ESC modem with two Ethernet 10/100/1000 BaseT RJ45s for M&C and traffic** respectively; Ethernet bridge, static routing; IPv4/IPv6 support; IEEE 802.1p QoS; IEEE 802.1q VLAN support **IF operation 50 to 90MHz and 100 to 180MHz** **L-band operation 950 to 2050MHz**; high-stability 10MHz reference; FSK Viterbi BPSK/QPSK/OQPSK FEC rates 1/2, 3/4 & 7/8; Intelsat Reed-Solomon outer codec AUPC: Automatic Uplink Power Control Web browser monitoring tools: Spectrum Display, Constellation Monitor, TCP/IP throughput Internal Bit Error Rate Tester (BERT) for non-DVB-S2 modes
Tx-only Option		Transmit functions only
Rx-only Option		Receive functions only
Data Rate Options		5Mbps data rate: extends base operation to 5Mbps
		10Mbps data rate: extends 5Mbps operation to 10Mbps
		25Mbps data rate: extends 10Mbps operation to 25Mbps
		60Mbps data rate: extends 25Mbps operation to 60Mbps
		100Mbps data rate: extends 60Mbps operation to 100Mbps (FastLink & DVB-S2 only)
		155Mbps data rate: extends 100Mbps operation to 155Mbps (DVB-S2 only)
XStream IP™		Traffic Shaping: supports CIR/BIR/priority settings for IP streams classified by IP address, Diffserv class, IEEE 802.1p priority tag or MPLS EXP field
		Header Compression: IP/UDP/TCP/RTP packet header compression (RFC 3095) plus Ethernet header compression
		Payload Compression: TCP/UDP packet payload compression using the Deflate algorithm (RFC 1951)
		Dynamic Routing: RIP, OSPF and BGP
		TCP Acceleration
		DVB-S2 ACM. Requires DVB-S2 hardware option
		*Please note that if Encryption (TCP/IP packet payload encryption using AES with 256-bit keys) is required then you should order the **Q-FlexE** model. This is identical to the standard Q-Flex in every other respect. The Q-FlexE is subject to export controls.*
DVB-S2 (hardware option) *To 155Mbps subject to prevailing modem data rate limits*		DVB-S2 CCM Tx: DVB-S2 QPSK, 8PSK & 16APSK Tx operation per EN 302 307. Includes DVB-S2 encapsulation: encapsulation of IP packets and Ethernet frames over DVB-S2 using Paradise eXtreme Protocol (PXE), MPE or ULE
		DVB-S2 CCM Rx: DVB-S2 QPSK, 8PSK & 16APSK Rx operation per EN 302 307. Includes DVB-S2 encapsulation: encapsulation of IP packets and Ethernet frames over DVB-S2 using Paradise eXtreme Protocol (PXE), MPE or ULE
FastLink™ Low-latency LDPC (hardware option) *To 100Mbps subject to prevailing modem data rate limits*		FastLink™ LDPC includes BPSK, QPSK, 8PSK, 8QAM, 8QAM, 16QAM, 32APSK & 64QAM
Paired Carrier™ (hardware option) *Subject to prevailing modem data rate limits.* *Occupied bandwidth: minimum 30kHz; maximum 54MHz*		Paired Carrier™ hardware option (requires one or more options below); allows Tx & Rx carriers to be overlapped, reducing the required satellite bandwidth
		Paired Carrier™ up to 256kbps (requires Paired Carrier™ hardware option)
		Extends Paired Carrier™ up to 512kbps
		Extends Paired Carrier™ up to 1.024Mbps
		Extends Paired Carrier™ up to 2.5Mbps
		Extends Paired Carrier™ up to 5Mbps
		Extends Paired Carrier™ up to 10Mbps
		Extends Paired Carrier™ up to 15Mbps
		Extends Paired Carrier™ up to 20Mbps
		Extends Paired Carrier™ up to 25Mbps
		Extends Paired Carrier™ up to 40Mbps
		Extends Paired Carrier™ up to 50Mbps
		Extends Paired Carrier™ up to 60Mbps
		Extends Paired Carrier™ up to 80Mbps
		Extends Paired Carrier™ up to 100Mbps
		Extends Paired Carrier™ up to 155Mbps

Configuration options continue on next page.

Fully configurable - pay only for what you need!

	Option	Description
Terrestrial Interfaces (please choose up to four of these hardware options)		G.703 (providing unbalanced G.703 on 2xBNC 75Ω sockets and balanced G.703 on RJ45); includes G.703 clock extension providing a high-stability reference clock over satellite (alternative to GPS); includes Drop & Insert
		EIA-530 (D25 DCE providing RS422/X.21/V.35/RS232)
		Quad E1 Multiplexer (balanced G.703 on 4xRJ45 of which one is enabled by default; includes Drop & Insert, IBS satellite framing and MultiMux, which allows IP and/or EIA530 traffic, if EIA530 interface fitted, in place of one or two Quad E1 ports
		Enable Quad E1 second RJ45 (includes Drop & Insert); requires data rate option to 5Mbps
		Enable Quad E1 third RJ45 (includes Drop & Insert); requires second RJ45 option plus data rate options to 10Mbps
		Enable Quad E1 fourth RJ45 (includes Drop & Insert); requires second & third RJ45 options plus data rate options to 10Mbps
		MultiMux: allows IP and/or EIA530 traffic, if EIA530 interface fitted, in place of 1 or 2 Quad E1 ports (each MultiMux port limited to 2.048Mbps traffic rate)
		Quad ASI (4xBNC 75Ω sockets)
		STM-1/OC-3/Optical Gigabit Ethernet (small form-factor pluggable module)
		Serial LVDS (on 25-way D type connector)
		HSSI (on HD50 50-way SCSI-2 connector)
		IDR (to IESS 308; 50-way female D type connector); includes Advanced AUX (variable rate synchronous Aux channel; includes option to replace IDR audio channels with serial data); includes Audio option (for IBS carriers this allows 2 x audio in 64kbps or 2 x audio+64kbps data in 128kbps - requires IBS option)
TPC *To 60Mbps subject to prevailing modem data rate limits*		TPC includes BPSK, QPSK, OQPSK, 8PSK and 16QAM (Rates 5/16, 21/44, 3/4 in BPSK, QPSK, OQPSK; Rate 7/8 in QPSK, OQPSK; Rate 0.93 Paradise in QPSK, OQPSK; Rates 3/4, 7/8, 0.93 Paradise in 8PSK; Rates 3/4, 7/8, 0.93 Paradise in 16QAM)
Optimised Spectral Roll-off		Extends the standard 35%, 25% and 20% roll-off factors by allowing 5%, 10% and 15% roll-off selections
LinkGuard™		Signal-under-carrier interference detection web spectrum graph showing received spectrum and any interference underneath the received carrier while on traffic; automated alarm when interference rises above user-set threshold; supported for all non-DVB-S2 FECs and modulations
IBS		Satellite framing to IESS 309 with low-rate Intelsat ESC (to IESS 403) and high-rate IBS ESC
Legacy FEC Option		Sequential FEC (limited to 2.048Mbps); TCM 8PSK 2/3 to IESS 310
48V DC Input		K3018 48V DC Primary power input (in place of 100 to 240V AC input)
24V 200W BUC PSU		P3544 AC Input, 24V 200W DC to Tx BUC
48V 200W BUC PSU		P3543 AC Input, 48V 200W DC to Tx BUC
48V In & 24V BUC PSU		Floating 48V DC Input with P3546 +24V 200W DC to Tx BUC
48V In & 48V BUC PSU		Floating 48V DC Input with P3545 +48V 200W DC to Tx BUC
+48V In & 48V BUC PSU		Non-floating +48V DC Input with P3547 +48V 200W DC to Tx BUC